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ABSTRACT

As our society evolves from an industrial society to a computer literate, high technology, information society, educational planners must reexamine the role of postsecondary education in economic development and in intellectual capital formation. In response to this need, a task force on high technology was established to examine the following topics: the development of a perspective or a futures scenario for Ohio; human resource development of providers and consumers of postsecondary educational services; equipment and capital plan expenditures; and implications for program development, approval, and evaluation. After analyzing Ohio's strengths and weaknesses as well as its opportunities for and the threats against its successful transition to a high technology information society, members of the task force concluded that the evolution of a technetronic society in Ohio can develop in a systematic way if the state can manage the issue of intellectual capital formation. What is needed is a conceptual framework to guide Ohio and its institutions in such a way as to focus science and technology on the individual and quality-of-life issues. In response to this need, the task force has developed a detailed plan of action concerning strategic planning, human resource development, capital planning, and program development and review for the 1983-1985 biennium. (A summary of the specific task force recommendations is appended.) (MN)

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THE ECONOMIC AND SOCIAL IMPACTS OF THE TRANSITION FROM THE INDUSTRIAL SOCIETY TO A COMPUTER LITERATE, HIGH TECHNOLOGY, INFORMATION SOCIETY

by

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ABSTRACT

During recent years we have experienced the onset of a transformation to a new type of society. Masuda indicates:

> Mankind is now entering a period of transformation from an industrial society to an information society.... Man is now standing at the threshold of a period of innovation in a new societal technology based on the combination of computer and communications technology, quite unlike any of the past. Its substance is information, which is invisible. This new societal technology will bring about societal transformation which, in a double sense, is unprecedented.

This transformation to the information society is concerned with the shift from physical productivity of material goods to information productivity and can be expected to bring about fundamental changes in human values, in trends of thought, and in the political and economic structures of society. This learning and information society will be characterized as interactions between people and

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ideas and knowledge. What is fundamentally different about the transformation to the information society is the unprecedented infusion of new technology into the workplace and the scope and rate of change of contemporary technology.

The Chancellor of the Ohio Board of Regents has appointed a Task Force on High Technology. The charge of the Task Force is:

> The Task Force will examine the issues relative to the development of high technologies and will recommend policies the Regents should consider adopting in this area.

In order to deal with this charge, the Task Force analyzed critically information about (1) scenarios, trends and visions of the world, nation, and Ohio; (2) R & D expenditures; (3) economic data by industry: (4) Federal and state legislation and models and congressional reports; (5) the inventory of state resources; (6) the human side of reindustrialization, the conscience, and the social consequences; (7) alternative delivery systems of postsecondary education services; and (8) proposals such as "The Technology and Productivity Center of Ohio" and "The Ohio Business, Education, and Government Alliance."

Numerous issues will be important in the 1980's. No issue, however, will be as important as the relationship of postsecondary education to the economy. Foreign competition, technological advances, changes in productivity, high costs, plant obsolescence, and infrastructure deterioration have resulted in massive dislocations in our economy. In the past, postsecondary education has seen its relationship to the economy primarily in terms of providing an educated work force. In the future, this focus will continue to be important but not sufficient. New expanded relationships will be required between post-secondary education and the economy in the computer literate, high technology, information society. This paper will examine the economic and social implications of moving toward a society where "The Paperless Office" and "The Factory of the Future" become a reality and the role postsecondary education can play in intellectual capital formation for economic development.

THE THIRD WAVE

> A new civilization is emerging in our lives and blind men everywhere are trying to suppress it. This new civilization brings with it new family styles; changing ways of working, loving, and living; a new economy; new political conflicts; and beyond all this an altered consciousness as well. Pieces of this new civilization exist today. Millions are already attuning their lives to the rhythms of tomorrow. Others, terrified of the future, are engaged in a desperate, futile flight into the past and are trying to restore the dying world that gave them birth. [1]

* * * * * * * * * * *

The Maturation of Society

In The Third Wave, Alvin Toffler describes periods of society using the analogy of waves as indicators of societal change. The first wave was an agricultural society. The second wave was an industrial society. The third wave, the current one, is a technological society. Toffler elaborates on the turbulence created as one wave rolls in and another recedes through the examination of social, political, and economic forces.

Prior to the agricultural wave, humans lived in small, migratory groups and attended to their needs by foraging, fishing, and hunting. The agricultural wave began roughly ten millennia ago. "It crept slowly across the planet spreading villages, settlements, cultivated land, and a new way of life."[2] Land was a predominate value with people living in multi-generational households in small, scattered villages. A simple division of labor emerged of clearly defined castes and classes in a rigidly defined authoritarian structure with birth determining one's position in life. The economic force most prominent was what Toffler calls the "prosumer," that of most individuals consuming all which they produced.

Toffler estimates that the industrial society began about 1650-1750 and ended by 1955. Six underlying principles of this society are (1) standardization,

(2) specialization, (3) synchronization, (4) concentration, (5) maximization, and (6) centralization. A fundamental change in family structure evolved, a shift to a "nuclear" or two-generational family unit; grandparents and other relatives were left behind as families "streamlined" toward urban centers in search of work in the factory. The division of labor, hierarchial structure, and metallic character of the factory were incorporated into other major institutions of society. The economic force that emerged was a shift from essentially self-sufficient people and communities to "a situation in which the overwhelming bulk of all food, goods, and services was destined for sale, barter or exchange.... Everyone became almost totally dependent upon food, goods, and services produced by someone else."[3]

Toffler anticipates that the technological society, which will complete itself in the next few decades, will bring about a new way of life which is an anti-industrial society. Toffler foresees a major change in family structure and role, an electronically expanded family which will include relatives, friends, and colleagues in a "family cooperative." The cooperative will operate a small business based primarily in the home or "electronic cottage" away from urban centers because of locational flexibility provided by technology. Toffler identifies principles that will guide the political structure of the future as (1) minority power as evidenced in a demassified society, (2) semi-direct democracy through representing oneself, and (3) a break-up of the decisional logjam with the result that decisions would be made at the level where they belong. The economy of the technological society is envisioned as a balanced producer/consumer relationship with the producer consuming both goods and services s/he produces and those produced by others based upon a number of factors such as increased leisure time, cost/benefit, and personal satisfaction.[4]

Additional comment is appropriate about the character of each type of society and the rate of change. In the hunting and agricultural societies, mankind was concerned primarily with extracting things from nature. The transformation to the agricultural society was slow and based on rather simple technological innovation. The hunting and agriculture societies can be characterized as interactions between people and nature. In comparison, the transformation from the agricultural society to the industrial society occurred more quickly and was the result of technological advances in energy, transportation, communications, raw materials, and research and development networks. The industrial society can be characterized as interactions between people and goods or fabricated nature. More recently, advances in the industrial society have been the result of the integration of macro-technological systems, the aggregation of complex technological developments in each of the above mentioned networks.

During recent years we have experienced the onset of a transformation to a new type of society. Masuda indicates:

> Mankind is now entering a period of transformation from an industrial society to an information society.... Man is now standing at the threshold of a period of innovation in a new societal technology based on the combination of computer and communications technology, quite unlike any of the past. Its substance is information, which is invisible. This new societal technology will bring about societal transformation which, in a double sense, is unprecedented.[5]

This transformation to the information society is concerned with the shift from physical productivity of material goods to information productivity and can be expected to bring about fundamental changes in human values, in trends of thought, and in the political and economic structures of society. This learning and information society will be characterized as interactions between people and ideas and knowledge.

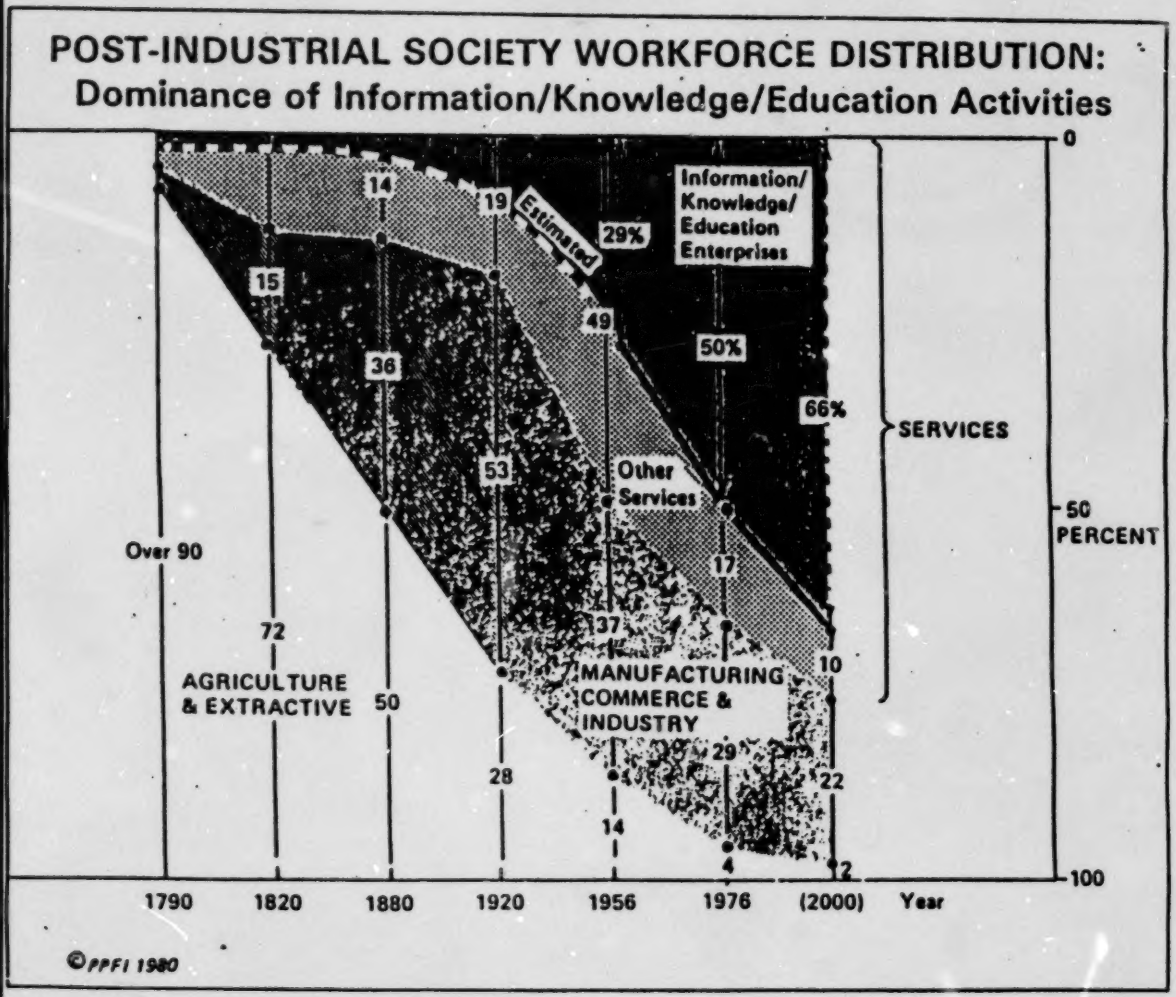
Molitor describes the transition from one type of society to another in terms of the workforce.[6] He indicates that in 1920, 53% of the American workforce was employed in manufacturing, commerce, and industry; 28% of the workers were engaged in agriculture and extractive industries; and 19% were employed in information, knowledge, education, and other service enterprises. By 1976, 29% were in manufacturing, 4% in agriculture, 50% were in information, and 17% were in other service occupations. By the year 2000, 22% are predicted to be in manufacturing, 2% in agriculture, 66% in information, and 10% in other services. (Figure 1)

Choate indicates that the compositon of America's workforce has changed significantly in the past four decades as a result of basic structural changes that are underway in the American economy.[7] (Figure 2) He indicates past change is mild, however, compared to what awaits us.

Boulding indicates that we are maturing toward a "vintage" society. He states:

> The maturation of our society, for good or for ill, will dominate change during the next decades. In biological organisms, senescence or death is inevitable when the biological potential of the original cell is exhausted. This does not have to happen in social organizations, or even total societies, because these structures are capable of a kind of social recombinant DNA. One sure sign of impending death for an organization or society is a fixed, uncritical worship of old ideas and ways that prevents adjustment to new situations. A society can restore its potential by replacing the old with the young in role structures and by developing "visions," renewals, and expansions of its original ideas.[8]

The changing nature of society has tremendous implications for its institutions for they are "of society." That is to say, institutions are created to fill a role that society has deemed necessary as it relates to its well being. Viewed in this light, the family, religion, elementary and secondary education, postsecondary education, human services, government at all levels, business and industry, housing, and transportation must develop mechanisms to impact on the quality of life to insure their viability. Strategic planning and management is a process which is being used by numerous institutions of society in an attempt to make them more responsive to the needs of society and insure their viability.



The distribution of workers in different sectors of the American economy changed dramatically over the last century, as society evolved from agricultural to post-industrial. Some important turning points were 1880, when 50% of the workers were in agriculture; 1920, when about 50% were in manufacturing; and 1976, when more than half were in information industries.

Source: Graham T. T. Molitor, "The Information Society: The Path To Post-Industrial Growth", The Futurist (April 1981, XV, No. 2 p. 24

Figure 1

Figure 2

THE CHANGED FACE OF AMERICA'S WORK FORCE

Sector	1940	1980	Percent Change
Agriculture	9,540,000	3,310,000	-65.3
Nonagriculture	32,361,000	90,564,000	179.8
Construction	1,311,000	4,399,000	235.5
Finance*	1,485,000	5,163,000	248.0
Government:			
Federal	996,000	2,866,000	187.7
State, Local	3,206,000	13,383,000	317.4
TOTAL	4,202,000	16,249,000	286.7
Manufacturing	10,985,000	20,300,000	84.8
Mining	925,000	1,020,000	10.3
Services**	3,665,000	17,901,000	388.4
Transportation, public utilities	3,038,000	5,143,000	69.3
Wholesale, retail trade	6,750,000	20,386,000	202.0

*Including insurance and real estate

**Including personal and business

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Washington, D.C. Computed by the New York Times, May 1982.

The unprecedented infusion of new technology into the workplace holds the promise of new industries with new jobs, of more creative work, of a more productive society, and of a society with more equality among its participants. Unfortunately, the application of technology in a different direction will cause legitimate and widespread concern. What is fundamentally different about contemporary technology is its scope and its rate of change. It must be remembered, however, that the application of technology is a product of human decisions.

The onset of a transformation to a new type of society is occurring at a time when illiteracy is a major problem in this nation. Numerous articles have been written in recent years about the growing number of functionally incompetent, scientific illiterate,[10] and the growing illiteracy problem for business when employees lack reading and writing skills necessary for their work.[11] An article in the Boston Sunday Globe indicated that it is scandalous that Johnny and Janie cannot write when they enter college, "but it is perhaps less scandalous than the possibility that, when they emerge as bachelors of arts or science, they may be unable to describe either discipline in acceptable written English."[12] The magnitude of the problem is such that "one in five American adults (20 percent) is functionally illiterate--unable to read job notices, fill out job applications, make change correctly, shop, locate needed services, or understand even basic concepts pertinent to their lives such as insurance and banking."[13] The problem is compounded when to these forms of illiteracy are added (1) occupational illiteracy, (2) economic illiteracy, (3) research illiteracy, (4) management systems illiteracy, (5) information processing illiteracy, and (6) technologic illiteracy. The largest single challenge for this nation in the information society deals with managing the issue of intellectual capital formation.[14]

The Task Force on High Technology

During the summer of 1982, Dr. Edward Q. Moulton, Chancellor of the Ohio Board of Regents, appointed numerous persons to an Advisory Committee on Two-Year Campuses Academic Affairs. At its first meeting on September 2, Chancellor Moulton discussed the role of the ACTYCA. The role of ACTYCA includes an examination of the changing nature of society to assess the need for high technology programs and to recommend the location of specific programs at selected institutions with unique facilities and resources so that these programs serve a region of the state with participation in such programs through a consortial arrangement. A second role of ACTYCA is to recommend a pattern of program review, possibly shifting from a "vertical" review process to a "horizontal" review process--assessment of all programs in one category of the taxonomy in a given year. A third role of ACTYCA is to review rules which drive academic judgments about programs; for example, should success of a program be based on a set of criteria to allow for students completing a few selected courses tied to a set of goals other than degree completion? Three task forces were established to provide direction to each of these areas.

The Task Force on High Technology (TFHT) met for the first time on October 7, 1982. During that meeting the TFHT (1) selected its leadership, (2) reviewed its charge, (3) analyzed materials and (4) established a clearinghouse for the exchange of materials. The membership of the TFHT is located in Appendix A. The charge to the TFHT is as follows:

> "The Task Force will examine the issues relative to the development of high technologies and will recommend policies the Regents should consider adopting in this area."

The TFHT analyzed materials and discussed areas of focus such as (1) developing scenarios and visions of the future, (2) research and development expenditures, (3) economic data by industry, (4) Federal and state legislation and models,

(5) an inventory of state resources, (6) the human side of reindustrialization, and (7) alternative delivery systems of postsecondary education services. The TFHT specified four topics derived from the discussion of its charge and the review of areas of focus. These four topics focus on (1) the development of a perspective or a futures scenario for Ohio; (2) human resource development of providers and consumers of postsecondary education services; (3) equipment and capital plan expenditures; and (4) implications for program development, approval, and evaluation. A subgroup was appointed to define the term "high technology" as well as provide direction to each of these four topics. The chairperson of the TFHT coordinates the clearinghouse functions.

Definition. One of the first issues the TFHT had to deal with was to define high technology. An article in the Wall Street Journal stated that "'high tech' is looking more like the latest development fad to hit the streets of America."[15] The author goes on to state that "the concept of high technology or advanced technology is too vague to be useful. Some 'most advanced' technology exists for producing almost every good or service traded in the economy." In some instances it seems more appropriate to refer to advances in science and technology as "new" technology. When speaking of the transfer of technology, the phase "appropriate technology" is more in keeping with the idea that is being communicated.[16] "Appropriate technology" recognizes levels of technology development (See Figure 3) and is compatible with the concepts of stages and cycles of development. The TFHT adopted the following definition:

> The term "high technology" characterizes: processes, products and applications stemming from the latest scientific and technical development; utilization of high levels of artificial or machine intelligence and information/decision capabilities; and extension of human manual and intellectual capacities through the use of computer technology and the application of sophisticated physical principles.

A more detailed statement about definition is located in Appendix B.

Figure 3

LEVELS OF TECHNOLOGY DEVELOPMENT

	Low Technology	Medium Technology	High Technology
Drafting	T-Square and Drawing Board	Manually Operated Drafting Machine	Computer Aided Design
Calculating	Manual Calculators	Electronic Calculators	Microcomputers
Typewriters	Manual Typewriters	Electric Typewriters	Electric Typewriter with Storage
Tools	Hand Tools	Machine Tools	Computer Numerical Control
Biology	Basic Laboratory Analysis Equipment	Genetic Engineering	Cloning
Electricity	Vacuum Tubes	Digital Electronics	Laser/Electro-Optics

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Adapted from Ronald R. Watcke, "Partnership Vital to High Tech," Community and Junior College Journal, December/January 1982-83, 53 (4), pp. 28-31 +.

7a

Scenario Development Through Strategic Planning. What is fundamentally different about this period of time is the scope and rate of change of contemporary science and technology and its impact culturally, psychologically, socially, and economically. The technetronic, information society will have profound impact on the personal ethos or "space", on the workplace environment, and on relationships among institutions of society. What is needed is some way to monitor demographic, economic, social, and governmental planning variables in order to develop the most likely scenario from among the possible alternative futures.

Aggregate categories of data about the external environment include (1) demographic trends, (2) economic trends, (3) social indicators, (4) governmental planning, (5) technological advances, (6) changes in the workplace, (7) energy requirements, and (8) value shifts. Sample subcategories for the first three of the above-mentioned groupings are displayed in Figure 4.

The purpose of collecting and analyzing data is to develop the most likely vision or scenario from among the possible alternative futures based on historical and projective information. There is growing recognition that Toffler's "Third Wave" technological society holds the potential for the evolution of a humanistic, holistic, person-centered society and that computerization can assist in the development of that scenario. Demographics provide a good example of relationship of data analysis to scenario development. Demographic data about family composition in the U.S. are interesting. One of four white Americans is young, while one of three black Americans and one of two Hispanic Americans is young. Another important statistic is the fact that 38% of white American families have school age children while 66% of Hispanic American families have school age children. These statistics are U.S. averages and do not reflect geographic variations. The number of high school graduates between 1979 and 1995 will range from a decline of almost 60% in Washington, D.C. to an increase of almost 60% in Utah. Eleven states will experience a decline of more than 30% in the number of high school graduates

FIGURE 4

SAMPLE SUB-CATEGORIES FOR SUGGESTED DATA CATEGORIES

EXTERNAL ENVIRONMENT		
DEMOGRAPHIC CHARACTERISTICS	ECONOMIC TRENDS	SOCIAL INDICATORS
Population Size	Textile Industry	Population & The Family
Age Distribution	Auto Industry	Health & Nutrition
Sex Ratio	Electronics Industry	Housing & The Environment
Marital Status	Telecommunications Industry	Transportation
Ethnic and Cultural Characteristics	Health Care Industry	Public Safety
Education Levels	Agriculture Industry	Education & Training
Economic Status	Airline Industry	Work
Population Density	Energy Industry	Social Security & Welfare
Degree of Urbanization	Steel Industry	Income & Productivity
Racial Composition	Insurance Industry	Social Participation
Unemployment	Shipbuilding Industry	Culture, Leisure & Use of Time
Poverty & Deprivation	Biotechnology Industry	
Illiteracy	Aerospace/Space Industry	
Existence of Basic Community Services	Defense Industry	
Social, Political, Economic Well Being	Synfuel Industry	
	Mining Industry	
	Education Industry	

during that span of time. These data mean different strategies for the various states. A recent study by the Center for Public Resources, a business-oriented think tank based in New York City, indicates there is a serious gap between the skills that high school graduates bring to a job and the skills that employers need but that the schools,however, don't seem to recognize the problem.[17] CPR reached that conclusion after surveying businesses, schools and labor unions. Contending that an adequately skilled workforce is an important factor in a strong national economy, the report points out that 13% of white, 43% of black and 56% of Hispanic 17 year olds are functionally illiterate and that between 40% and 50% of all in urban areas have serious reading problems. These issues will become more severe as this nation moves to the information society including operationalizing the office of the future, the automated factory, the electronic college, and the electronic community.

Ohio is strategically located in the center of numerous major developments. Carnegie-Mellon University, the University of Michigan, and Cincinnati are leaders in the field of industrial automation and robotics. The University of Michigan's Center for Robotics and Integrated Manufacturing has been awarded a $3.4 million research contract by the U.S. Air Force Office of Scientific Research.[18] The Lewis Research Center of the National Aeronautics and Space Administration in Cleveland, the Battelle Memorial Institute, and the Air Force Wright Aeronautical Laboratories at Wright Patterson Air Force Base are major assets to Ohio (See Figure 5).

Strategic planning is, essentially, a process of developing a plan of action based on audit of strengths and weaknesses and an assessment of opportunities and threats. The intent is to capitalize on strengths, minimize weaknesses, take advantage of opportunities, and eliminate or reduce threats. In concert with the commitment to the new social compact, we must initiate a strategic planning process that includes technological and occupational forecasting.

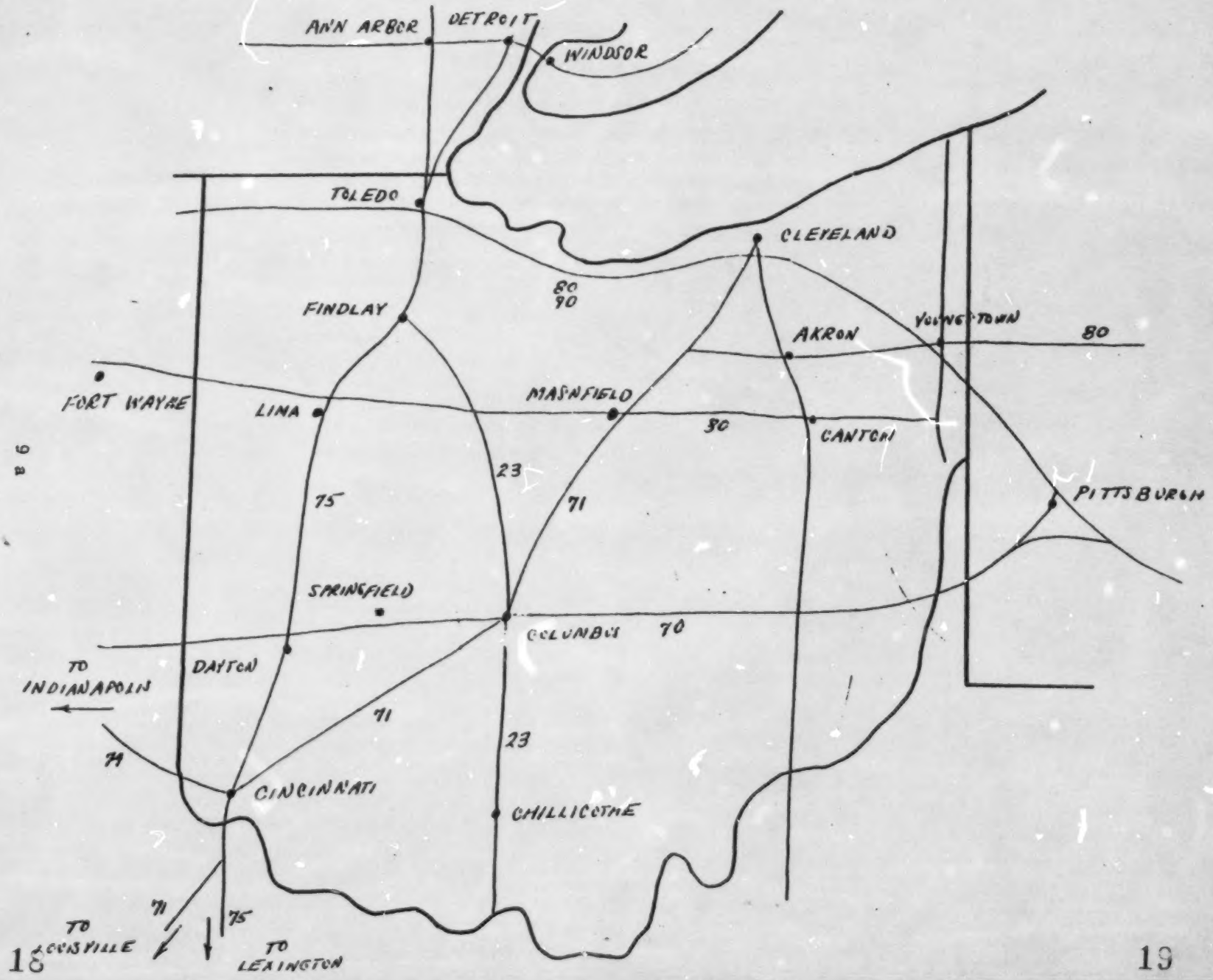

ANN ARBOR
DETROIT
WINDSOR
TOLEDO
CLEVELAND
80
90
FINDLAY
AKRON
YOUNGSTOWN
80
FORT WAYNE
LIMA
MANSFIELD
80
CANTON
23
75
71
PITTSBURGH
SPRINGFIELD
COLUMBUS
70
TO
INDIANAPOLIS
DAYTON
71
23
74
CINCINNATI
CHILLICOTHE
71
75
TO
LOUISVILLE
TO
LEXINGTON

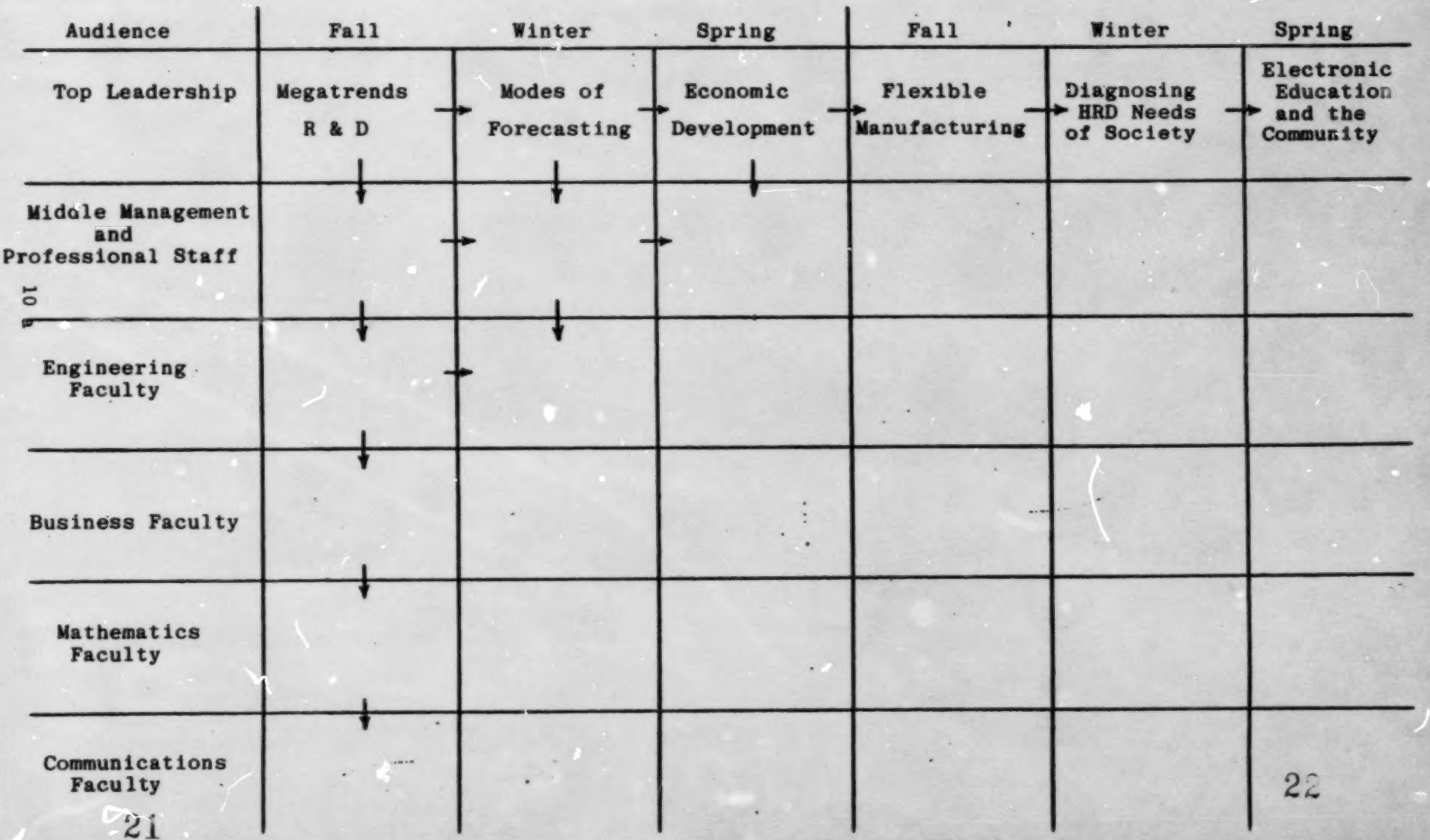
FIGURE 5

Human Resource Development. In Between Two Ages, the author indicates, "The paradox of our time is that humanity is becoming simultaneously more unified and more fragmented."[19] His "technetronic" society is shaped culturally, psychologically, socially, and economically by the impact of science and technology. Scientific and technical knowledge is becoming a major source of contemporary change. In the industrial society technical knowledge was applied primarily to the acceleration and improvement of production techniques with little thought to the social consequences. In the technetronic society, scientific and technical knowledge is enhancing production capabilities but also affecting almost all aspects of life directly. Reliance on "new techniques enhances the social importance of human intelligence and the immediate reliance of learning. The need to integrate social change is heightened.... Science thereby intensifies rather than diminishes the relevance of values...."[20]

In business and industry, human resource factors have accounted for 80% of the productivity growth in the U.S. since 1929. In the education and training industry, that percentage may be even higher. As the industrial society continues to recede and the technical, information society evolves, it is absolutely essential that occupational education be able to audit its human resources in order to develop plans for intellectual capital formation.

Although there will be any number of approaches which can be taken to the design and implementation of a comprehensive program for human resource development, it seems only logical that the effort during the first year should focus on developing a vision and specifying a most likely scenario for the state of Ohio. A "Management of Technological Innovation" seminar series should be developed based on topics such as megatrends, research and development, modes of forecasting, economic development, and industrial automation. In addition, the series should include seminars on "Diagnosing HRD Needs of Society" and "Electronic Education and the Community." (See Figure 6)

FIGURE 6. THE MANAGEMENT OF TECHNOLOGICAL INNOVATION SEMINAR SERIES



Time will not permit a detailed discussion of this plan of action, nor have the details of the seminar series been developed. Three examples will serve to illustrate the type of strategic planning that must be implemented if Ohio's people are to be the beneficiaries of science and technology.

The shuttle that went up on November 11, 1982, carried private satellites that will be used for teleconferencing and high speed data transmission. Developments in this field will lead to a number of occupations such as:

1. Computer Terminal Information Processor
2. Computer Terminal Distributive Information Processor
3. Telemarketing - Advertising Technician
4. Telemarketing - Sales Programmer
5. Telemarketing - Camera and Audio Recording Technician
6. Telemarketing - Consumer Order Specialist
7. Telemarketing - Operations Analyst Technician
8. Telemarketing - Sales and Shipping Clerks
9. Teletext - Cable TV Liaison Technician
10. Teletext - Marketing Specialist
11. Teletext - Software Technician
12. Teletext - Librarian
13. Teletext - Broadcast Communications Technician
14. Teletext - Operations Supervisor
15. Teletext - Interactive Correspondent Technician
16. Teletext - Senior Editor and Operations Director[21]

These new occupations could begin to absorb persons displaced from industries which are being phased out due to obsolescence or other reasons. Formal systems must be designed to systematically monitor advances in research and development and interpret their impact in terms of the critical mass of human resource requirements necessary to make the occupation become an operational reality. Our vocational, technical, and professional education systems must unite and take an anticipatory, proactive stance with regard to this phenomena.

The "Eminent Scholars Program" should be implemented as a way of developing excellence at Ohio's postsecondary institutions in selected strategic areas.[22] A recent study be the National Academy of Science contains a dismal portrait of the quality of doctoral programs in Ohio. The study found that (1) the quality of 71 of 108 programs were rated as deteriorated over the last five years, (2) only 2 of 115 programs were ranked in the top third compared with those in the same

disciplines at other universities around the country, and (3) the geography program at The Ohio State University was the only program that was ranked among the top 10 in its field in the nation.[23] If the telecommunications industry has implications for Ohio, a critical number of eminent scholars could be located at a major institution near the NASA Lewis Research Center to provide leadership in the field. In addition, selected technician programs could be located at two-year institutions in close proximity to the eminent scholars. This effort could not only provide jobs as listed above but could also impact on the electronic delivery of educational programs and services, something that would have to be coordinated with the Chancellor's Higher Education Telecommunications Committee.

Another "megatrend" relates to this nation's posture on military spending be it of the offensive or defensive "Star Wars" variety. The President is calling for a $2 trillion five-year military spending plan of which $663 billion is for weapons, most of the amount for fewer than 50 high cost items.[24] Much of the cost centers on 8 controversial weapons systems that are scheduled to cost $154.6 billion over the next decade:

(1) 100 MX Intercontinental Ballistic Missiles . . . . $26.4 Billion
(2) 2 Nimitz-Class Aircraft Carriers . . . . . 7.4 Billion
(3) 6,882 Bradley Fighting Vehicles . . . . . 13.4 Billion
(4) 100 B-1 Swing-wing Strategic Bombers . . . . . 29.5 Billion
(5) 446 AH-64 Apache Attack Helicopters . . . . . 7.4 Billion
(6) 1,366 F/A-18 Hornet Navy Fighters . . . . . 39.7 Billion
(7) M1 Abrams Main Battle Tank . . . . . 19.5 Billion
(8) Patriot Air Defense System . . . . . 11.3 Billion

Of the $238.6 that the Pentagon is requesting for the fiscal year starting October 1, 1983, $94.6 billion, more than one third, is earmarked for weapons research and procurement.[25] Implications of the "Star Wars" defense, pitting weapons against weapons instead of people, are too complex to discuss in terms of strategic

desirability or technological feasibility be it comprised of chemical lasers, mirrors in space, particle-beam weapons, nuclear-pumped x-ray lasers, or some other advanced technology.[26] The Pentagon is currently working on a three-part space-based project to determine its feasibility by 1987 before developing the prototype. Both an offensive and a defensive military posture have tremendous implications for Ohio's industries and the human resources necessary to (1) develop and produce the systems and (2) operate and maintain them.

In addition to communications and defense, there is the example of the nonaligned Third World nations. The nonaligned nations movement began in 1959 and recently held its seventh conference. The world economic crisis has helped the group to realize that their economic recovery is largely dependent on the United States and its Western partners in the form of aid and know-how.[27] The nonaligned Third World nations have most of the 75% of markets which lie outside the United States. Strategic planning in this instance would mean we must identify some of mankind's most serious problems and analyze how Ohio's resources can be applied to them.

Thus, telecommunications, defense, and problems of the nonaligned Third World nations represent opportunities to revitalize Ohio's economy. Insights about what to do are derived from the systematic collection and periodic analysis of demographic, social, economic, technological and other data. These data become the foundation for the analysis of <u>strength</u>, <u>weakness</u>, <u>opportunities</u>, and <u>threats</u> and provide us with a sense of mission and assist us to develop a plan of action to which purposeful human activity can be linked. (A "barebones" SWOT analysis is displayed in Figure 7.)

If postsecondary education is to remain viable in a rapidly changing information and service oriented society, it must make a major commitment to human resource development to the <u>providers</u> of education and training services.

Figure 7

SWOT ANALYSIS

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
The Batelle Institute	State Funding of Education	Telecommunications	Ohio's decline from 34th (1981) to 44th of 48 contiguous states as an attrative manufacturing site.
Diversity of Business Establishments	Student Fee Assumption 1980-81 33% 1981-82 37% 1982-83 44%	NASA Lewis Research Center	- 4th highest manufacturing wages
Land Availability	Participation in Higher Educ.	Robotics	- 3rd highest time lost due to work stoppage
Transportation - Highway, Air, Rail	Quality of Doctoral Programs: Only 2 strong Ph.D. Programs 71 of 108 deteriorated over the last 5 years 71 of 109 were below average	Center for Robotics - Michigan	- 1st in expenditure in environmental control
Water	Use of Educational Technology	Robotics Institute - Carnegie Mellon	- 46th in state and local taxes
Geographic Location		Just-In-Time Manufacturing	Competition from Other States and Regions
Leadership Organizations IUC-OTCCA 7 WFS Chapters 8 ASTD Chapters		Structural Dynamics Research Corporation	
Ohio Technology Transfer Organization			
Jt. Commission of Voc-Tech Education			
Committee on Higher Education Telecommunications			
Eminent Scholars Prospect			
Ohio Council for Interinstutional Research(OCIR)			
Ohio Assn. for Staff, Program, and Org. Dev. (OASPOD)			
Ohio Assn. of Two-Year Colleges	Intramural Strategic Planning Intermural Strategic Planning		

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Professional preparation and professional continuing education is an extraordinary complex task today. Most faculty were graduated from undergraduate and graduate programs which focused on performing a service role or doing research as opposed to becoming an educator. Their programs dealt minimally, if at all, with curriculum content formats, how to teach and evaluate student learning, or the distinction between how traditional and non-traditional students learn. And now the rapid change of "content" is threatening the one thing most persons used to feel comfortable about. The problem is even more complex at the mid and top management levels.

Are there signs that the education industry could be more responsive to the insatiable needs of consumers in the learning society? A 1978 study indicated that only 1 in 4 persons seeking a higher education experience is enrolled in U.S. colleges and universities even though 36% of the population between 16 and 65 is in some form of career transition.[28] Over the past several years, phenomenal growth occurred for a broad range of education and training providers including business and industry, the department of defense, professional associations, adult education associations, and proprietary organizations. The National Conference Board, for example, indicated that in the single recession year of 1975 this nation's 7,500 largest private employers spent over $2 billion on employee education or as much as the recent annual totals of all contributions from all sources to colleges and universities.[29] In 1979, an article in The New York Times stated, "The American Telephone and Telegraph company spent $700 million on educational programs for its employees, or more than three times the $213 million annual budget of the Massachusetts Institute of Technology."[30] An article in the May 1980 issue of the Training and Development Journal stated, "Industry spends on employee education more than six times the amount appropriated by all the staes for all of higher education."[31]

In 1981, an article in The New York Times stated, "Within a short drive of Boston, a city with no shortage of higher education, are four new degree-granting programs that are not even affiliated with a college or university. They are sponsored by a hospital, a bank, a consulting firm, and a computer manufacturer."[32]

The information society will require new skills for a broad range of consumers. Demographics again provide an example. If all of this state's people are to benefit from science and technology, our institutions must be cognizant of the shifting demographics and the research about illiteracy reported earlier in this document. Shifting demographics for Cleveland, Columbus, and the U.S. average are as follows:

	Cleveland		Columbus		U.S. Average	
	1970	1980	1970	1980	1970	1980
White	61.1	53.5	81.0	76.2	87.5	83.2
Black	38.3	43.8	18.4	22.1	11.1	11.7
Hispanic	2.1	3.1	0.6	0.8	4.5	6.4
Asian	N/A	0.6	N/A	0.8	N/A	1.5

These data have tremendous implications for educational planners.

More recently postsecondary education has been asked to become proactive in economic development. Although the precise role that postsecondary education will play in economic development is yet to be determined, it is clear that new relationships must be established between postsecondary education and the economy, especially business and industry and local communities. Both of these two areas are worthy of discussion.

"Employees and Establishments By Industry" are displayed in Figure 8. Research indicates that 80% of new jobs are created by establishments no more than 4 years of age and with 20 or fewer employees.[33]

Cooper and Dunkelberg found that most enterpreneurs started their companies when they were 25 to 40; many are highly educated with 36% having 16 or more years of schooling; and about 50% had entrepreneural parents.[34]

FIGURE 8

EMPLOYEES AND ESTABLISHMENTS BY INDUSTRY, 1979

	Number of Employees	Number of Establishments	Number of Establishments By Employment Size								
			1-4	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000+
Agriculture, forestry, fisheries	9226	1930	1454	282	132	59	7	3	2	-	-
Mining	32192	1154	422	241	201	178	58	34	9	9	2
Contract construction	182005	19364	12012	3587	2036	1235	316	142	27	6	3
Manufacturing	1414824	15800	3519	2421	2804	3047	1628	1394	599	264	214
Chemicals	47950	653	134	89	121	132	71	61	29	12	4
Petroleum/coal	7161	168	55	30	29	25	15	8	1	5	-
Rubber/plastics	100479	852	135	76	105	201	139	122	46	13	15
Stone/glass	52421	977	207	172	195	194	91	78	19	15	6
Primary metals	148712	633	78	52	77	130	98	85	58	28	27
Fabricated metal products	178283	2248	337	279	457	526	289	237	76	24	23
Machinery	216119	3515	887	683	683	650	250	198	88	43	33
Electric/electronic	108036	611	107	66	75	100	79	84	45	30	25
Transportation equipment	176012	398	55	45	59	60	38	49	35	26	32
Instruments	24619	297	66	45	50	56	28	27	16	5	4
Transportation	200869	6577	2708	1127	1076	948	376	230	85	25	22
Wholesale Trade	279939	16563	6409	3953	3208	2205	546	191	35	13	3
Retail trade	751815	56526	25449	14289	8505	5609	1880	651	116	26	11
Finance, Ins, R. Estate	211125	18521	10699	3726	2154	1171	350	138	47	25	11
Services	708079	57306	33716	11728	6224	3487	1178	686	170	83	66
TOTAL	3833422	201238	103203	41908	26531	18007	6339	3338	1070	451	331

SOURCE: Ohio County Business Patterns 1979 (Washington, D. C.: Bureau of the Census, 1981) pp. 3-15.

In addition, research by Cooper indicates that the most important dimensions leading to new product success are (1) product uniqueness and superiority, (2) market knowledge and marketing proficiency, and (3) technical and production synergy and proficiency.[35] This type of research helps to provide direction for our efforts to assist business and industry.

Other research data suggest that our future is, for the most part, dependent upon the preservation, expansion, and creation of small businesses. "A recent study by the Office of Management and Budget found that small businesses tend to be more innovative, despite the government's preference for giant corporations in handing out research funds. The study found that small businesses accounted for almost half of all major innovations in the 1953-73 period and produced four times as many innovations per researcher as big business at a cost per scientist or engineer only half of big business."[36] In Ohio, the 189,000 small firms created 66 percent of all new jobs in the private sector between 1969 and 1976; 80 percent of new jobs came from businesses less than five years old. Fifty percent of the state's workforce is classified as employed by small business; these firms generate 51 percent of the gross state product. Small businesses, however, have demonstrated they are unable to afford the type of assistance which is usually available to large corporations.[37]

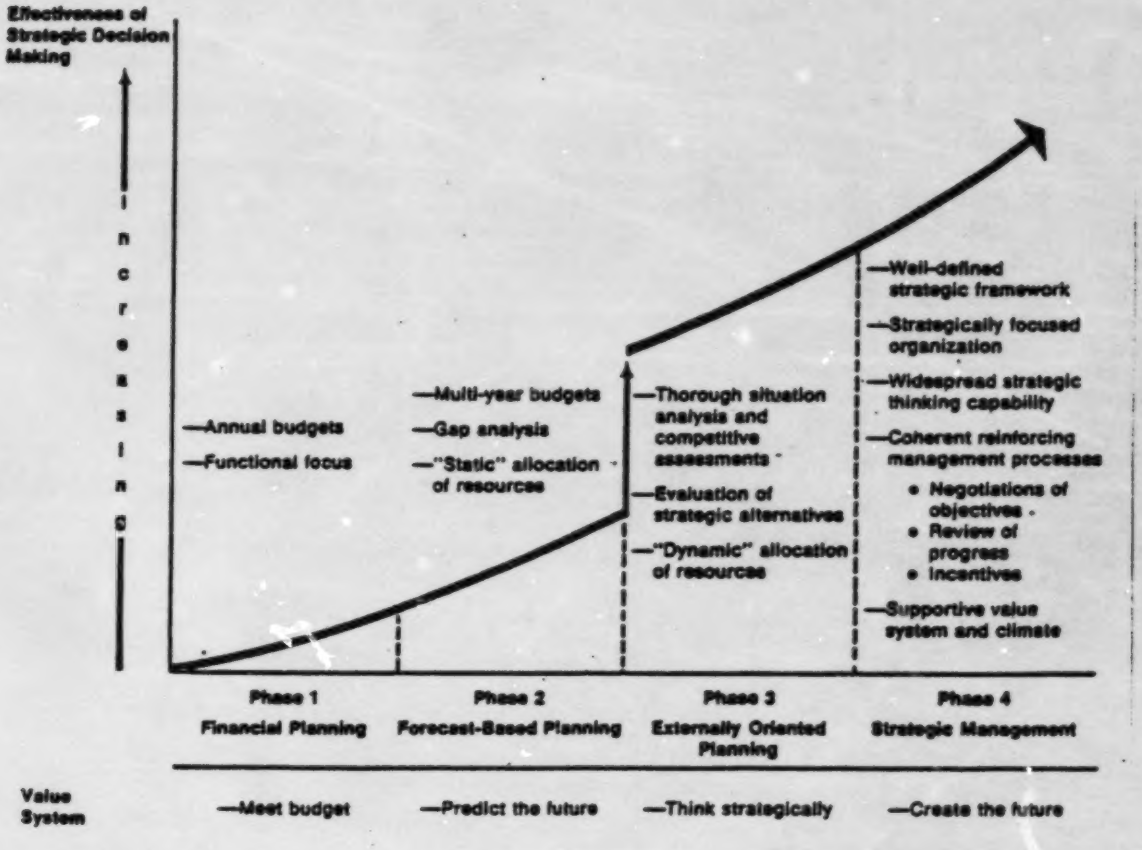
Economic development means attracting, retaining, and expanding business and industry. Postsecondary education's commitment to economic development mandates an understanding of cycles and stages of development. With regard to organizational development, one widely utilized view of the developmental sequence represents evolution progressing from small to integrated to diversified. A number of writers have suggested stages beyond the three-stage model. Steinmetz proposes a four-stage model consisting of direct supervision, supervised supervisor, indirect control, and divisional organization.[38] His labels deal with methods of control, thus he focuses directly on the need for changes

in style at various stages of development. Greiner describes five stages each with its own management style to achieve growth (1) creativity, (2) direction, (3) delegation, (4) coorindation, and (5) collaboration.[39] Between each stage a particular crisis is posited, thus requiring a style change. These crises involve first leadership, then autonomy, then control, and finally a participative style of mutual goal setting through a matrix of teams. James has a somewhat different concept of the organizational life cycle by focusing more on the problems faced at each phase of evolution; his five stages include (1) emergence, (2) growth, (3) maturity, (4) regeneration, and (5) decline.[40] The concept of stages of corporate development for computer/data processing activities has been described by Nolan as (1) initiation, (2) contagion, (3) control, (4) integration, (5) data administration, and (6) maturity.[41] The phases of evolution leading to corporate strategic decision making have been described as (1) financial planning - meet the budget, (2) forecast-based planning - predict the future, (3) externally oriented planning - think strategically, and (4) strategic management - create the future.[42] (See Figure 9)

It is becoming increasingly clear that the strategies an organization uses are influenced by its position in a developmental sequence. All of the models emphasize the style and strategy changes associated with growth and the problems associated with these changes. Organizations at different stages of evolution tend to elicit different managerial and organizational styles. This will often mean that those who led the organization at one stage may not be able to do so effectively at another. In the first stage an organization requires a single guiding executive who basically operates a "one-person show." Such executives tend to be rather authoritarian, to emphasize short term thinking, and to have an operating orientation. In the second stage a group of managers with functionally specialized responsibilities replaces the single

FIGURE 9

Phases in the Evolution of Strategic Decision Making



Source: Frederick Gluck et al (1982) "The Four Phases of Strategic Management" The Journal of Business Strategy.

authoritarian executive. Thus, the chief executive must be able to work with members of the management team and utilize their talents effectively. The move to other stages is accompanied by a divisionalized structure with loose control over the operating units while stressing long-term strategic planning.

The commitment to economic development goes beyond new relationships with business and industry as a consumer to include community development, particularly in the area of high technology. A report of the Joint Economic Committee of the Congress of the United States indicates the following:

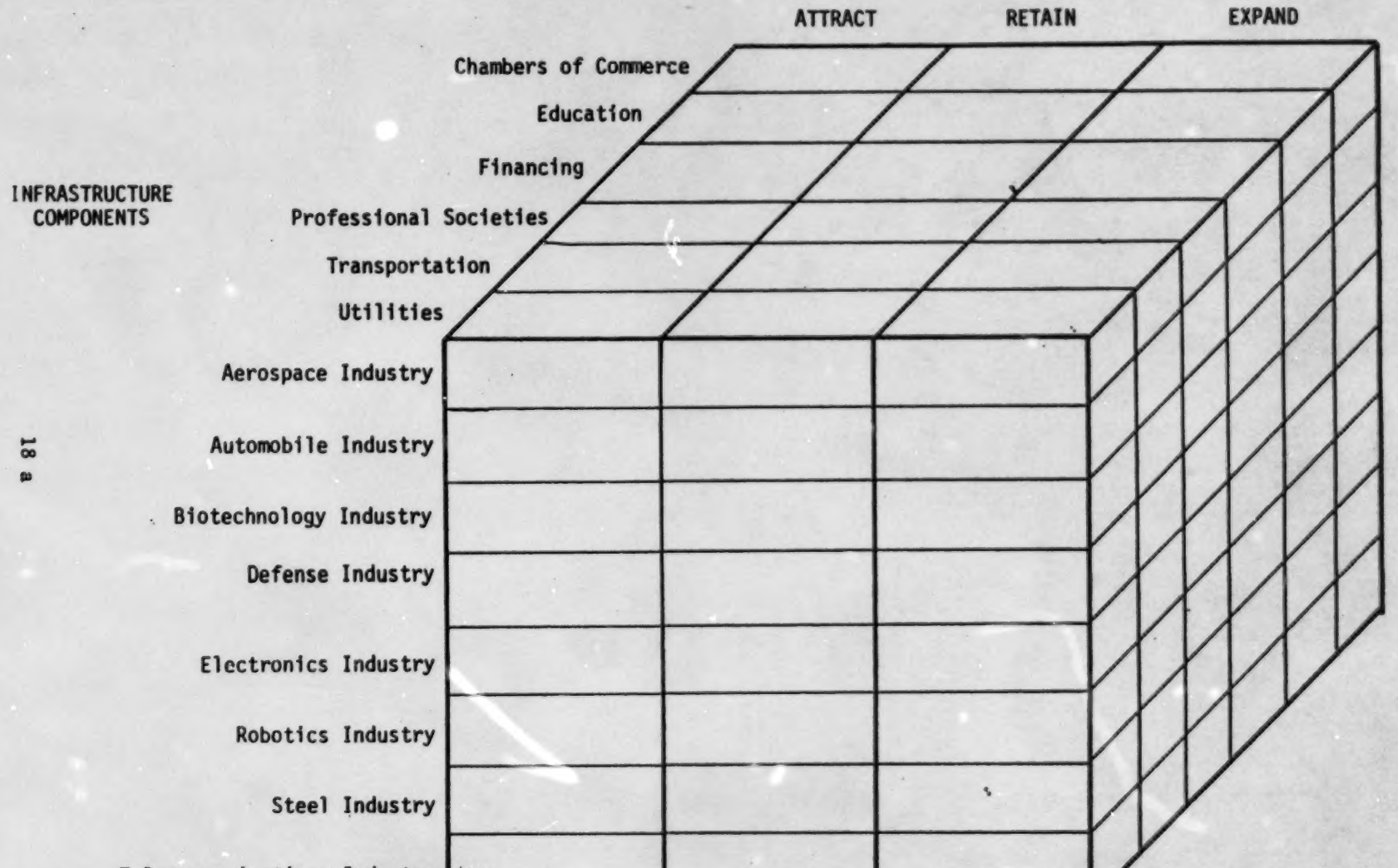
> High technology industries consist of heterogeneous collections of firms that share several attributes. First, the firms are labor-intensive rather than capital-intensive in their production processes, employing a higher percentage of technicians, engineers and scientists than other manufacturing companies. Second, the industries are science-based in that they thrive on the application of advances in science to the marketplace in the form of new products and production methods. Third, R & D inputs are much more important to the continued successful operation of high technology firms than is the case for other manufacturing industries. Although analysts have reached no general agreement on a definition of high technology industry, there is a general agreement that the following Standard Industrial Classification (SIC) industries qualify: chemicals and allied products (SIC 28); machinery, except electrical (SIC 35); electrical and electronic machinery, equipment and supplies (SIC 36); transportation equipment (SIC 37); and measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks (SIC 38).

Thus, the challenge in terms of community development is to diagnose the infrastructure components necessary to attract, retain, and expand the industries that are essential in the information society. (See Figure 10).

What should be evident by this time is the need for a major commitment to human resource development, both for <u>providers</u> and <u>consumers</u> of education and training services. It is for these reasons that a "Management of Technological Innovation" seminar series is built upon the topics of megatrends, research and development, modes of forecasting and economic development.

FIGURE 10

INFRASTRUCTURE DEVELOPMENT TO ATTRACT, RETAIN, AND EXPAND
BUSINESS AND INDUSTRY



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Capital Planning. The $10 M for equipment in the 1981-83 biennial bill was divided among the institutions on the basis of full time equivalent student enrollment. Another $10 M for equipment is included in the 1983-85 biennial bill. That amount is needed to upgrade existing equipment and would be far from adequate for funding strategic needs relating to high technology. In addition, there is need to dedicate fiscal resources to the use of technology in the process of instruction. A commitment to strategic planning, including technological and occupational forecasting, and human resource development at the beginning of the 1983-85 biennium would provide approximately one year to develop the blueprint and specifications to be included in the 1985-87 biennium request and also be raw material for the 1986 Master Plan for Higher Education. (See Figure 11) It also is logical to argue that supplemental equipment requests be synchronized with physical plant planning requests, both of which are linked to program development.

Program Development and Review. In the area of program development and review, three items appear to be important. First, the process of program review is currently being examined; special characteristics such as cost, location, and infrastructure requirements of high technology programs should be considered in relation to emerging needs of economic and industrial development. Second, unique characteristics of high technology programs should be included in discussions on articulation. Third, innovative delivery systems for education and training programs should be promoted and a set of specifications should be developed to deliver such programs.

Figure 12 is a display of these recommendations in "A Plan of Action for the 1983-85 Biennium." A "Summary of Recommendations" is attached. What is being suggested is that postsecondary education must take a proactive leadership role in the transformation from an industrial society to an information society.

FIGURE 11 MULTI-YEAR OPERATIONAL BUDGET PLANNING CALENDAR

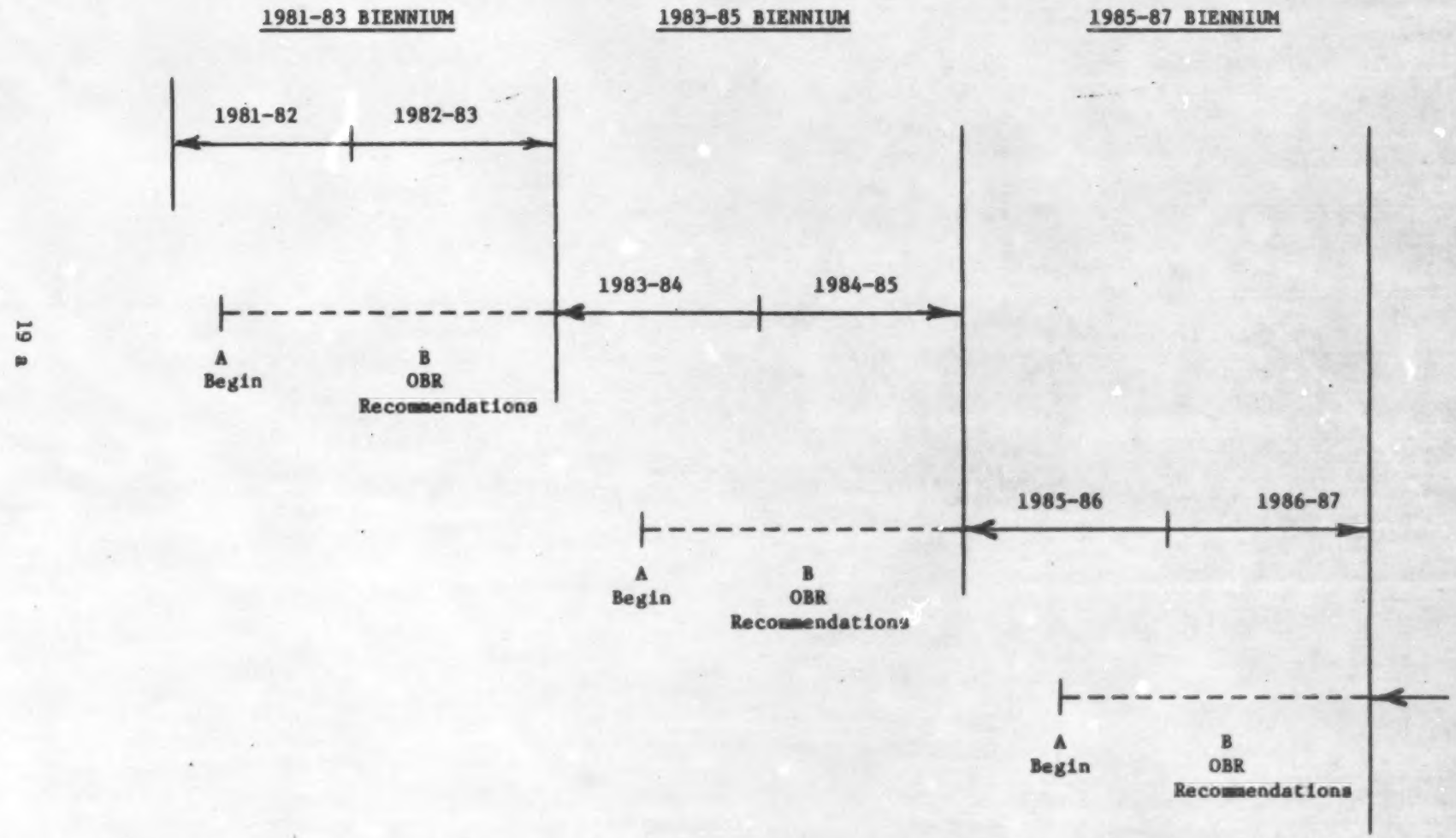

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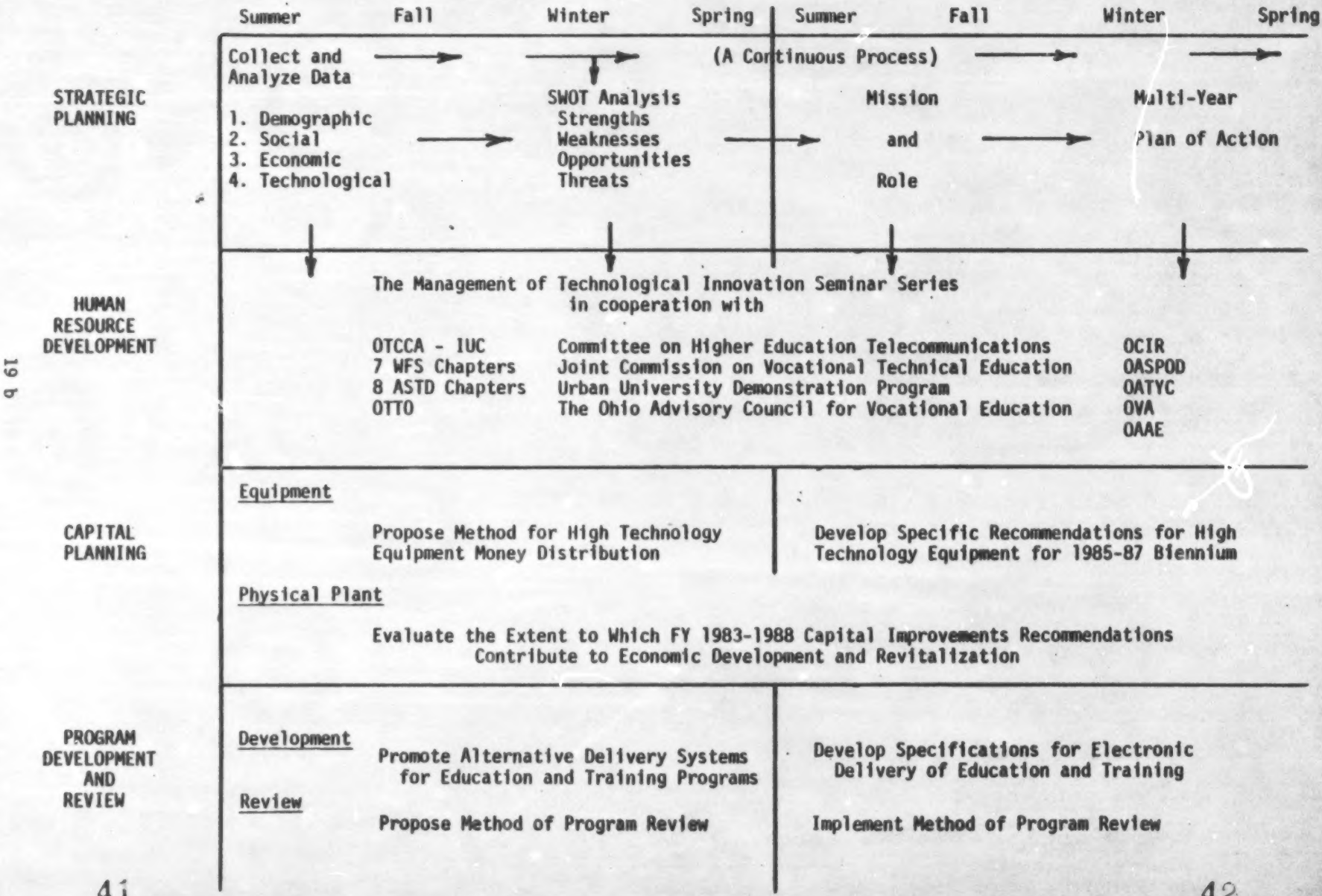
Figure 12

A PLAN OF ACTION FOR THE 1983-85 BIENNIUM



In Megatrends, John Naisbitt states:

> Things are not going to get better, things are going to get different. We are not in a recession, we are in something much more profound than that. We are changing economies and we haven't changed economies for a hundred and fifty years.
>
> Of course, there is a lot of uncertainty but we have got to make uncertainty our friend. We have had an economy that rested on the industrial sector, which has served us magnificently for so long, but now we are shifting to a new economy that rests on information and electronics. This is not going to happen tomorrow; it is happening today. We are more in the new economy than we are in the old economy.[43]

Conclusion

The industrialized nations of the world are in the turbulent times of a structural shift from an industrial society to a technological society. The scope and rate of change of science and technology is unprecedented and it impacts culturally, psychologically, socially, and economically. The central question is how it will affect society and whether people will be the beneficiaries or victim of science and technology. What is needed is a conceptual framework to guide our state and its institution in such a way that we focus science and technology on the individual and quality of life issues.

The evolution of the technotronic society in Ohio can develop in a systematic way if the state can manage the issue of intellectual capital formation. Many of the old smoke stack industries of America's heartland and foundry are gone forever.[44] Economic recovery will be spread unevenly across the nation attributable, in part, to a variety of forces such as the military buildup and defense and aerospace contracts.[45] Economic and demographic forces are making the various sections of the country less, not more, alike.[46] Many call high tech the panacea.[47] Those who are of that persuasion should examine the location of plants by Zenith, RCA, General Electric, Hewlett-Packard, Mattel, and Atari in Puerto Rico, Hong Kong, Taiwan and Asia.[48]

In summary, numerous issues will be important in the next decades. No issues will be more important, however, than the relationship of postsecondary to the economy and intellectual capital formation. In the past, postsecondary education saw its relationship to the economy primarily in terms of providing a trained workforce. This focus will continue to be important in the future but not sufficient. New expanded relationships will be required between postsecondary education and the economy in the computer literate, high technology, information society.

Strategic planning and management is one means for managing the issue of intellectual capital formation in our society's evolution toward a humanistic, person-centered society that is the beneficiary of science and technology. We have the tools. Do we have the spirit and are we willing to commit the resources to dedicate our institutions as instruments to develop that type of society? As one futurist stated: "A future that isn't forecast is like an accident waiting to happen."[49]

FOOTNOTES

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APPENDIX A

TASK FORCE ON HIGH TECHNOLOGY

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APPENDIX B

HIGH TECHNOLOGY. WHAT IS IT?

An article in the Wall Street Journal stated that "'high tech' is looking more and more like the latest development fad to hit the streets of America." The author goes on to state that "the concept of high technology or advanced technology is too vague to be useful. Some 'most advanced' technology exists for producing almost every good or service traded in the economy."

In some instances it seems more appropriate to refer to advances in science and technology as "new" technology. When speaking of the transfer of technology, the phase "appropriate technology" is more in keeping with the idea that is being communicated. Watcke attempted to display stages of technology development and relate that concept to curriculum development and point to the need to develop partnerships within a college's service area. A modified display of "levels of Technology Development" is displayed in FIGURE 1.

FIGURE 1

LEVELS OF TECHNOLOGY DEVELOPMENT

	LOW TECHNOLOGY	MEDIUM TECHNOLOGY	HIGH TECHNOLOGY
Drafting	T-Square and Drawing Board	Manually Operated Drafting Machine	Computer Aided Design
Calculating	Manual Calculators	Electronic Calculators	Microcomputers
Typewriters	Manual Typewriters	Electronic Typewriters	Electric Typewriter with Storage
Tools	Hand Tools	Machine Tools	Computer Numerical Control
Biology	Basic Laboratory Analysis Equipment	Genetic Engineering	Cloning
Electricity	Vacuum Tubes	Digital Electronics	Laser/Electro-Optics

Adapted from Ronald R. Watcke, "Partnership Vital to High Tech," Community and Junior College Journal, December/January 1982-83, 53 (4), pp. 28-31+.

"High Technology" could be defined as any influence of the computer on (1) engineering and design (2) planning and scheduling, (3) fabrication and assembly, and (4) marketing and distribution. Such a definition seems most appropriate to the manufacturing of durable goods. With this definition the Task Force on High Technology should be interested in concepts related to the automated factory (AF) or the "factory of the future." Terms associated with these concepts are as follows:

Computer Aided Technology	CAT
Computer Aided Design	CAD
Computer Aided Enginering	CAE
Computer Aided Manufacturing	CAM
Group Technology	GT
Manufacturing Planning and Control Systems	MPCS
Automated Materials Handling	AMH
Materials Requirements Planning	MRP
Automated Time Standards	ATS
Computer Assisted Process Planning	CAPP
Manufacturing Resources Planning	MRP II
Computer Integrated Manufacturing	CIM
Integrated Computer Aided Manufacturing	ICAM
Data Based Management Systems	DBMS
Computer-Aided Inspection Test and Control	CAITC
Finite Elements Analysis	FEA

Business and industry, however, is not the only establishment experiencing the impact of the computer. Computer aided transcriptions are becoming a practice in reporting in the courts. In the education industry, computer-aided instruction and computer-managed instruction are appropriate to include in the definition. Other terms are also appropriate. Telematics, for example, is a collective term including computer, information, and telecommunication technologies.

Several lists of advances in technology have appeared in various journals. High Technology lists the following fields experiencing rapid growth:

.Genetic engineering. The technology associated with putting biological knowledge to work. Applications in the chemical industry, pharmaceuticals, agriculture.

.The electronic office. Multifunction work stations. Word-speech recognizers and simplified programming that will humanize the interface between people and machines. The costs, the benefits, the potential savings.

.Automotive technology. Improvements in auto engines that will save money and reduce emissions. Research to overcome the limitations of potential competitors to the internal combustion engine.

.Communications. Interactive television: the technology and its likely impact on entertainment, education, business, banking, retailing. Electronic mail. High-speed facsimile. Microwave links between offices. Teleconferencing.

.Construction. Energy-efficient architecture. Cost-saving materials. Labor-saving methods.

.Space technology. The Space Shuttle: how it will boost our capability to orbit satellites and even build space stations. New uses for orbiters -- including navigation, geophysical exploration, crop studies, weather prediction.

.Energy. Thin-film photovoltaic cells and the promise of low-cost solar-generated electricity. Improved batteries and storage systems. The technology of fusion power and the obstacles that must be overcome.

.Military/aerospace technology. Rapid strike force equipment. Stealth aircraft. Passive detection systems. Automatic target recognition systems. Laser weaponry.

.Transportation. Light-rail vehicles. Magnetic levitation for high-speed trains. Computer-tracked fast freight. Hydrofoils. Dual-mode personal rapid transit.

.Medical technology. Implantable replacement body organs, artificial limbs, diagnostic devices, information retrieval and medical data systems.

.Robotics. The move toward fully-automated assembly lines. New machining methods. Energy-efficient production methods.

.New materials. Fiber-reinforced composites (carbon, baron, etc.) and "foamed" metals, which combine high strength with light weight. Inexpensive alloys that can substitute for more costly metals. Superconductors. New coatings, adhesives and other materials.

.Measurements. New tools for measuring a wide range of phenomena. High-speed observation of dynamic processes, chemical reactions, sub-atomic particles. Cosmological observations.

.Personal computers. What's new and what's next. What they offer and how they can be used. Advances which will make them more useful, more popular.

.Artificial intelligence. Machines that think for themselves -- or for you. (The question is not whether this will happen, but when.) And how we'll deal with the social dislocations as menial work is phased out.

Several persons have listed high technology industries or devices and processes which are commonly encompassed by the term high technology. Two such lists are displayed in FIGURE 2. The "High Technology Industries" list was developed by Watcke and the "Devices and Processes" list was developed by Walter Edling of Lorain County Community College.

FIGURE 2

HIGH TECHNOLOGY INDUSTRIES	DEVICES AND PROCESSES
Genetic Engineering	Computers (including personal computers)
Telecommunications Equipment	Lasers
Electronic Components	Fiber optics
Pharmaceuticals/Health Chemicals	Nuclear processes
Energy and Power Supplies	Microelectronics (and nano- and picoelectronics)
Bio-Medical Equipment (medical scanners, pacemakers, implants)	Artificial intelligence
Computer Equipment (peripherals)	Computer Numerical Control (CNC) and Direct Numerical Control (DNC)
Computer Software and Supplies	Computer Aided Engineering and Design (CAE, CAD)
Security Detection Equipment (fire emergency)	Computer Aided Manufacturing (CAM) and Integrated Computer Aided Manufacturing (ICAM, CIAM)
Home Computers	Alternate energy forms (Solar cells, etc.)
CAD/CAM Systems	Computer-supported Management and Planning Systems
Mainframe Computers	Robots
Office Automation Equipment (word processing)	Molecular biology
Semiconductors/Integrated Circuits	Voice Recognition
Lasers and Infrared Equipment	Holography
CATV (cable television)	Telecommunications
Microwave Equipment	
Military Systems	
Test Equipment (quality assurance)	
Electromechanical Components (robots and numerical control)	

Helms lists advances in communications, computers, robotization, biotechnology, electric power, fuels technology, material technology, and body technologies and the key words associated with each category. (See FIGURE 3) Moody lists components of the office of the future or the paperless office as word processing, personal computers, electronic mail, computer assisted retrieval, computer output microfilm, facsimile devices, teleconferencing, and reprographics. (See FIGURE 4)

A report of the Joint Economic Committee of the Congress of the United States states:

> High technology industries consist of heterogeneous collections of firms that share several attributes. First, the firms are labor-intensive rather than capital-intensive in their production processes, employing a higher percentage of technicians, engineers and scientists than other manufacturing companies. Second, the industries are science-based in that they thrive on the application of advances in science to the marketplace in the form of new products and production methods. Third, R & D inputs are much more important to the continued successful operation of high technology firms than is the case for other manufacturing industries.
>
> Although analysts have reached no general agreement on a definition of a high technology industry, there is a general agreement that the following Standard Industrial Classification (SIC) industries qualify: chemicals and allied products (SIC 28); machinery, except electrical (SIC 35); electrical and electronic machinery, equipment and supplies (SIC 36); transportation equipment (SIC 37); and measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks (SIC 38).

During the summer of 1982, Dr. Edward Q. Moulton, Chancellor of the Ohio Board of Regents, appointed numerous persons to an Advisory Committee on Two-Year Campus Academic Affairs. The Advisory Committee is an umbrella structure for several subcommittees and task forces, one of which is the Task Force on High Technology. The charge to the TFHT is as follows:

> "The Task Force will examine the issues relative to the development of high technologies and will recommend policies the Regents should consider adopting in this area."

The TFHT appointed a subgroup to define high technology. The subgroup proposed the following definition:

> The term "high technology" characterizes: processes, products and applications stemming from the latest scientific and technical development; utilization of high levels of artificial or machine intelligence and information/decision capabilities; and extension of human manual and intellectual capacities through the use of computer technology and the application of sophisticated physical principles.

The Task Force adopted this definition unanimously at its meeting on February 3, 1983.

* * * * * * * * * * * * * * *

A future that isn't forecast is like an accident waiting to happen.

Earl C. Joseph, 1982

Figure 3

ADVANCING TECHNOLOGIES OF THE 21st CENTURY

Technology Category	Key Words
COMMUNICATIONS	Computerized PBX's, Satellites, Telemarketing, Cable TV, Videodisc, Videotex, Teletext, Telemarketing, Photonics, Optical Fibers, Mass Memory Exchange, Industry and Office Automation, Lasers.
COMPUTERS	Very Large Scale Integration (VLSI), Photonics, Photo Computers, Holographic Memories, Verbalization, Voice Synthesis, Voice and Pattern Recognition, 5th Generation Computers (Japan), Artificial Intelligence, Integrated Circuits, Microchips, Microprocessors, Word Processors, Computer Graphics, CAD, CAM, COMCAM, GENPLAN, EFT, FMC, FMS, Robotics.
ROBOTIZATION	Productivity, Cost Benefits, Quality, Up Time, Employee-Lay Offs, Retirement, Machine Intelligence, Machine Sensing, Machine Vision, Electronic Neuron, Photo Computers, Gray Imaging, Verbalization, Pattern Recognition and Selection, Microprocessor, Microchip, Reindustrialization, World Cars, Mergers, Electronics, Steel, Textiles, Survivability.
BIOTECHNOLOGY	Bioengineering, Genetic Engineering, Gene Splicing, DNA, RNA, Hybridomas, Mutants, Enzymes, Plasmids, Regeneration, Green Revolution, Cloning.
ELECTRIC POWER	Photovoltaic Cells, Solar Energy, Fuel Cells, Helium Gas Turbines, OTEC, Fusion, Liquid Metal Breeders, Geothermal, Windmills, Biomass, Magneto-Hydrodynamics (MHD).
FUELS TECHNOLOGIES	Coal Gasification, Liquefaction, Shale, Tar Sands, Catalysis, Syncrude, Synfuels, Gasohol, Methane, Ethanol, Biomass.
MATERIAL TECHNOLOGIES	New Microsciences, Ceramics, Synthetic Fibers, Fiber Reinforced Composites, Polymers, Epoxies, Glass Beads, Metallic Glass, Plasma Process, Splat Cooling.
BODY TECHNOLOGIES	Artificial Organs: Hearts, Kidneys, Lungs, Valves, Blood Vessels, Bone Conduction Hearing, Electronic Vision. Fluoric Ion Application, Polystyrene, Polyurethane, Teflon, Implants, Transplants, Utah Arm, Leg, Hand--Bionics.

SOURCE: W. Clyde Helms, Jr., President, Occupational Forecasting, Incorporated.

FIGURE 4

THE OFFICE OF THE FUTURE OR THE PAPERLESS OFFICE*

WORD PROCESSING

development, revision, and production of documents such as letters, reports, labels, and directories.

PERSONAL COMPUTERS

small but powerful computers that can provide groups of users with capabilities such as filing, retrieval, sorting, word processing and report creation without the need for extensive programming or reliance on a large central processor.

ELECTRONIC MAIL

electronic work stations and message systems to send messages to one or more addresses where the communications can be read on their electronic equipment and respond at their convenience.

COMPUTER ASSISTED RETRIEVAL (CAR)

a combination of a computer system and a microfilm storage and retrieval device to get information from massive files that are stored on roll microfilm or microfiche.

COMPUTER OUTPUT MICROFILM (COM)

a computer process which produces information on microfilm instead of on paper.

FACSIMILE DEVICES

a way of transmitting pages of copy, such as correspondence or contracts, over long distances.

TELECONFERENCING

a method of simultaneous remote communication involving many people that may be as simple as a speakerphone conference call or as elaborate as a live video conference with terminals or facsimile devices for transmitting images, whether graphic or narrative.

REPROGRAPHICS

the use of electronics in the preparation of documents that can include input of original text through word processors linked directly to electronically controlled equipment that can set type in a multitude of type styles and sizes as well as automatically generate logos, form outlines, and charts and graphs.

*Source: H. Gerald Moody, "The Face of the Future: The Office," Voc Ed, January/February, 1982, pp. 36 and 83.

APPENDIX C

SUMMARY OF RECOMMENDATIONS

Scenario and Role

Recommendation 1. The Ohio Board of Regents should implement a strategic planning process which focuses on economic and industrial development and emphasizes high technology.

Recommendation 1b. The Ohio Board of Regents' strategic planning process should be integrated with other local, regional, and state-wide goal setting projects.

Recommendation 1c. The Ohio Board of Regents' strategic planning process should emphasize technological and occupational forecasting.

Recommendation 1d. The Ohio Board of Regents should develop a mission, role and scope of work statement for technical education in support of the computer literate, high technology, information society.

Human Resource Development

Providers

Recommendation 2a. The Ohio Board of Regents should design and implement a comprehensive program for human resource development.

Recommendation 2b. The Ohio Board of Regents should specify a plan of action to modify the existing Management Information System in order to regularly audit the human resources contained within higher education.

Consumers

Recommendation 2c. The Ohio Board of Regents should develop a mechanism to fund continuing education for economic and industrial development.

Capital Planning

Recommendation 3. The Ohio Board of Regents should request supplemental money to fund high technology equipment and develop a procedure for awarding the additional money to qualifying institutions.

Program Development and Review

Recommendation 4a. In its re-examination of the program development and review process, the Ohio Board of Regents should consider the special characteristics of cost, location, and infrastructure requirements of high technology programs in relation to emerging needs of economic and industrial development.

Recommendation 4b. It is recommended that the unique characteristics of high technology programs be included in discussions on articulation.

Recommendation 4c. The Ohio Board of Regents should promote innovative delivery systems for education and training programs and develop specifications to include electronic delivery of such programs.